Compact, Rugged and Low-Cost Atmospheric Ozone DIAL Transmitter, Phase II

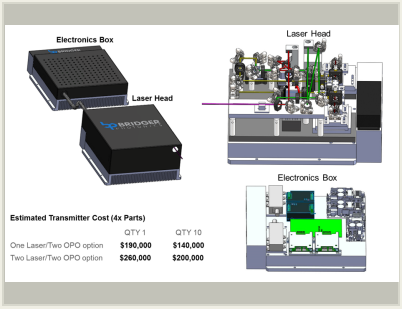
Completed Technology Project (2016 - 2021)

Project Introduction

Real-time, high-frequency measurements of atmospheric ozone are becoming increasingly important to understand the impact of ozone towards climate change, to monitor and understand depletion of the ozone layer, to further understand its role in atmospheric chemistry, and to assess its impact on human health and the productivity of agricultural crops. Expansions of tropospheric ozone measurement efforts, such as NASA?s TOLNet program, are critical to improve our understanding these effects. In response to this need, Bridger Photonics Inc proposes developing the most efficient, compact, rugged, low-power consumption and cost-effective UV ozone differential absorption lidar (DIAL) transmitter available. The proposed transmitter will enable widespread deployment of ozone DIAL systems capable of continuous range-resolved atmospheric ozone measurements from ground-based and airborne platforms to advance NASA?s Earth science mission. To achieve this design goal, Bridger will apply innovations proven out during its Phase I effort and developed previously for its MIR series laser product. The overall project goal is to design, construct, and test an autonomous, production-grade prototype, two-wavelength ozone LIDAR transmitter. The proposed transmitter will enable state-of-the-art continuous ozone LIDAR measurements without the need for a skilled operator. It will also provide a long maintenance-free interval (> 2 years), and will cost under $200k per transmitter. Successful completion of this Phase II program will allow Bridger to demonstrate a simultaneous DIAL, brassboard transmitter with pulse energies >200 ?J in both DIAL wavelengths capable of autonomous operation, without degradation, for 3 months.

Anticipated Benefits

NASA?s primary application for the proposed transmitter would be for widespread deployment of ground-based and airborne sensors to map ozone concentrations with high spatial and temporal resolution. This will allow NASA to carry out its Earth Science missions with smaller and/or more affordable DIAL transmitters enabling NASA programs to meet multiple mission needs and make the best use of limited resources. Our system will be highly useful for both integrated column and range-resolved measurements due to its short pulse durations and scalable high energies. Additionally, our base pump laser can be frequency down-converted into the SWIR spectral band rather than frequency up converted to the ultra-violet band. This will enable compact single-mode, high-energy pulses for profiling other important greenhouse gases and pollutants such as CH4, CO2, H2O, CO, NO2, and many others. Finally, the base pump laser when frequency doubled into the visible region will enable compact single-mode, high-energy pulses for profiling of cloud and aerosol backscatter, ice mass and phytoplankton measurements, and direct-detection Doppler LIDAR wind measurements.The pump laser for the proposed design would be the most compact and high energy kilohertz-rate Nd:YAG laser on the market. Bridger envisions a wide variety of applications for this



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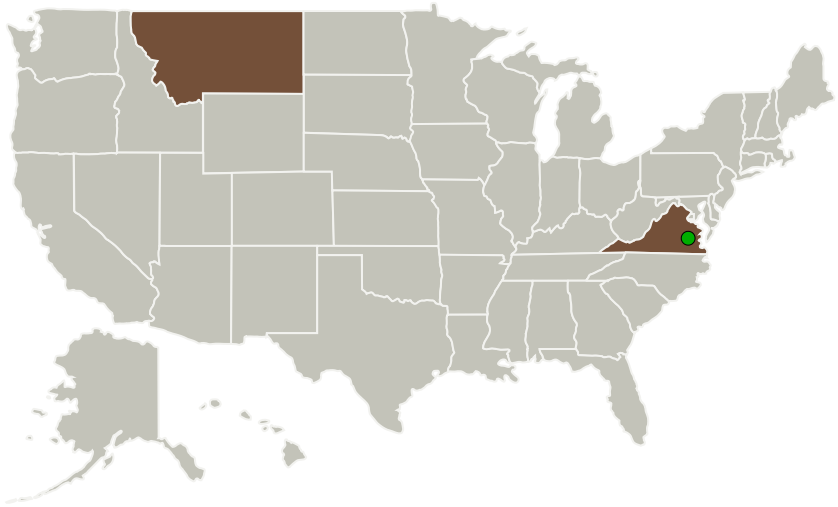
laser including gas sensing lidar, hard-target ranging, ablation applications including mass spectrometry, nonlinear spectroscopy and as general purpose OPO pump. To date Bridger?s MIR Series has been sold primarily to laser ablation mass spectrometry customers, but Bridger has experienced interest from customers for hard-target ranging and nonlinear spectroscopy applications. Within the lidar market both NOAA and the EPA would be potential customers for the complete UV transmitter to advance their ozone monitoring initiatives. Other commercial markets include detection of illicit methamphetamine labs, on-site pollution detection, verification of carbon sequestration sites, methane pipeline monitoring, and chemical weapons detection. The proposed transmitter could easily be adapted to detect a host of other gasses, most of which are detected in the short wave infrared and mid-infrared spectral regions and are well suited to a seeded version of Bridger?s existing OPO.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Bridger Photonics, Inc.	Lead Organization	Industry	Bozeman, Montana
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Bridger Photonics, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Managers:

Johnathan W Hair
Keith L Woodman

Principal Investigator:

Jason Brasseur

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Completed Technology Project (2016 - 2021)

Primary U.S. Work Locations	
Montana	Virginia

Project Transitions

May 2016: Project Start

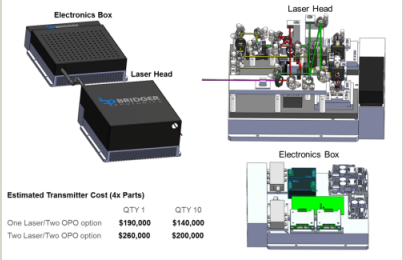
February 2021: Closed out

Closeout Documentation:
- Final Summary Chart*(https://techport.nasa.gov/file/139874)*

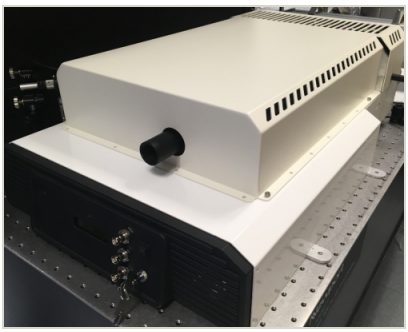
September 2021: Closed out

Closeout Documentation:
- Final Summary Chart PDF*(https://techport.nasa.gov/file/139873)*

Images



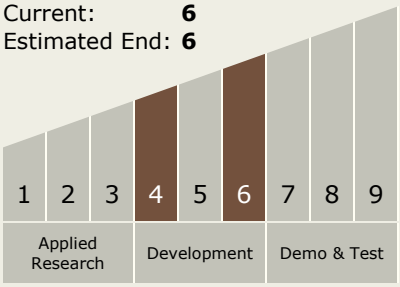
Briefing Chart Image
Compact, Rugged and Low-Cost Atmospheric Ozone DIAL Transmitter, Phase II *(https://techport.nasa.gov/image/136364)*



Final Summary Chart Image
Compact, Rugged and Low-Cost Atmospheric Ozone DIAL Transmitter, Phase II *(https://techport.nasa.gov/image/132471)*

Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System